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The Morpho-Species Concept of *Euphyes dion* with the Description of a New Species (Hesperiidae).

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Abstract. *Euphyes alabamae* (Lindsey, 1923) and *Euphyes macguirei* (Freeman, 1975) fall within the normal range of variation of *Euphyes dion* (Edwards, 1879), and are reduced to synonyms of *E. dion*. The type series of *E. macguirei* probably resulted from unique rearing conditions; no specimens fitting the original description of this taxon have ever been collected in the wild. *Euphyes alabamae* is at best a weakly defined subspecies in which one of the many phenotypes of *E. dion* if fairly stable. A unique *Euphyes* population from Bay St. Louis, Mississippi, differs subtly, but consistently, from all *E. dion* populations and is described as *Euphyes bayensis* new species. Preliminary biological evidence suggests that the new species differs from *E. dion* in habitat requirements and hostplant choice.

Introduction

The genus *Euphyes* is distributed through most of the western hemisphere and contains approximately 20 species. The genus is composed of four well defined species groups (Shuey, 1986) which differ primarily in the configuration of the female genitalia. The *dion* group contains six species level taxa (*E. dion* [Edwards], *E. dukesi* [Lindsey], *E. macguirei* Freeman, *E. pilatka* [Edwards], *E. berryi* [Bell], and *E. conspicua* [Edwards]), all of which are confined to wetland habitats. An additional taxon, *E. alabamae* (Lindsey), is usually considered a subspecies of *E. dion*, but often has been placed as a distinct species (e.g., Clark and Clark, 1951; Forbes, 1960; Miller and Brown, 1981). Because of their restricted habitat requirements, these species are localized and among the least collected skippers in eastern North America.

The *dion* group (sensu Shuey, 1986) contains two problematic names which refer to taxa of uncertain status, *E. alabamae* as mentioned previously, and *E. macguirei*, which has remained an enigma to most lepidopterists since its recent description. The resolution of these taxa's status has been hampered by their relative rarity and the difficulty of amassing sufficiently long series to investigate interspecific variation. My purpose is to briefly examine the status of the two problematic taxa, and to describe a new species from southern Mississippi.

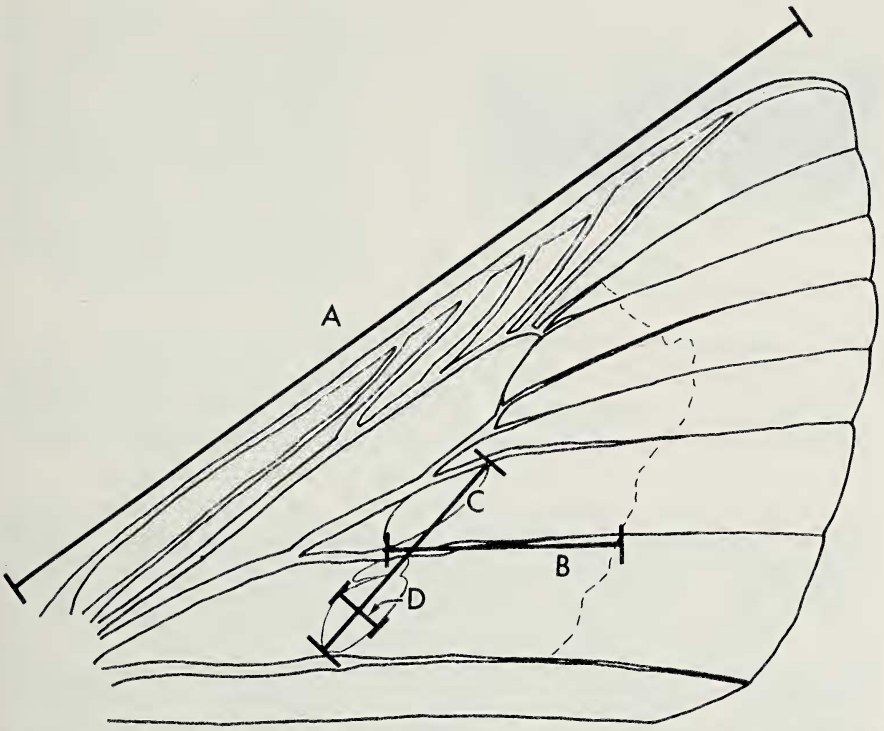


Fig. 1. Wing measurements recorded; A — wing length; B — extent of orange pattern along vein V_2; C — stigma length; and, D — stigma width.

Materials and Methods

I examined material of all the *dion* group species. Particulary relevant material included several hundred specimens of the *dion/alabamae* complex from throughout eastern and central North America; the holotype male of *E. alabamae*; the holotype male and allotype female of *E. macguirei*; and a series of 32 males and nine females of an undescribed taxon from southern Mississippi.

For wing pattern analysis, 20 males and 20 females were randomly selected from series of the *dion/alabamae* complex from Ohio+Indiana and Mississippi and the undescribed taxon (only nine females of this taxon were available). Characters measured (Fig. 1) with an ocular grid included forewing costa length (to the nearest 1/2mm), extent of the orange pattern along vein V_2 (to the nearest 1 4mm), stigma length (to the nearest 1/4mm), and stigma width (to the nearest 1/8mm).

PROBLEMATIC NAMES

Euphyes macguirei Freeman, 1975. This taxon was described from a short series (four males and one female) of reared specimens from Benbrook Reservoir, Tarrant Co., Texas. Although Miller and Brown

Fig. 2. *Euphyes macguirei*—like adults reared from Logan Co., Ohio ova. Both specimens were reared on poor quality cuttings of *Carex lacustris*. Similarities to *E. macguirei* include small size (forewing length 15 mm and 14.5 mm respectively), and reduced orange pattern elements.

(1981) accepted this taxon as a valid species, most lepidopterists have been skeptical about its status, presumably because of the unique circumstances surrounding all of the known specimens and their similarity to *E. dion*. This is probably the only butterfly in North America which has never been captured; all specimens known to me have been reared. Freeman (1975) listed five characteristics which separated. *E. macguirei* from *E. dion*. Unfortunately, none of these characteristics can withstand close scrutiny.

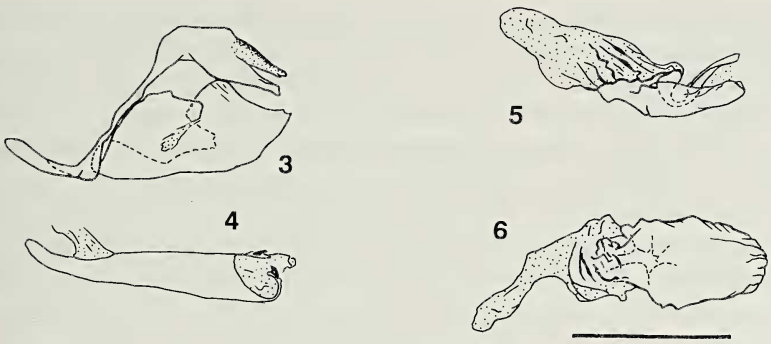
1. "smaller size" — Indeed, the type series is composed of specimens that are noticeably smaller than typical *E. dion*. However, all of the types were reared from a locality that also supports *E. dion*. Since reared specimens are often smaller than individuals that develop under natural conditions, it seems likely that the type series might have resulted from stressed larvae. I have produced similar-sized and patterned specimens (Fig. 2) from Ohio ova by providing larvae with very poor quality (low moisture content) cuttings of the sedge *Carex lacustris* Willd.

2. "more elongated fulvous streak throughout the cell in the ♂♂ on the secondaries" — The holotype male does not have a noticeably expanded streak on the hindwing. Furthermore, the expression of this pattern element is variable in the *E. dion/alabamae* complex, and the variation easily encompasses the pattern observed on the *E. macguirei* holotype.

3. "the absence of fulvous markings between the stigma and the base of the wings" — Again, this is a variably expressed pattern element in *E. dion*, and occasional specimens do not have any fulvous color between the stigma and the wing base (Fig. 7).

4. "the yellowish veins on the lower surface of the secondaries, which are absent or else poorly defined in [*E.*] *dion*" — The veins of fresh *E. dion* are always yellow and contrast strongly with the ground color. Freeman most likely compared reared *E. macguirei* with flown material of *E. dion*, and mistook the natural loss of scales from the veins of *E. dion* as a real pattern element.

5. "it differs" ... "in the genitalia" — Freeman's figure of the genitalia does differ significantly from any known *Euphyes*, and if it were accurate, might deserve generic status! However, the holotype



Figs. 3-6. *Euphyes macguirei* genitalia;
Fig. 3. male genitalia, lateral view; Fig. 4. aedeagus, lateral view; Fig. 5. female genitalia, lateral view; and Fig. 6. female genitalia, ventral view. Scale line = 2 mm.

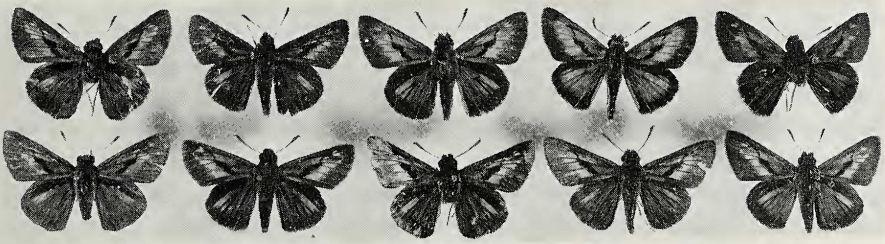


Fig. 7. Phenotypic variation of wing pattern in Ohio and Indiana *E. dion*. These specimens were selected to show the range of variability. **First row**, left to right; OH., Logan Co., 16-VII-1983 (JS); OH., Williams Co., 18-VII-1954 (OSU); OH., Williams Co., 28-VI-1959 (OSU); IN., Steuben Co., 12-VII-1983 (JS); OH., Portage Co., 11-VII-1982 (JS). **Second row**, left to right; OH., Erie Co., VII-1896 (OSU); OH., Williams Co., 6-VII-1962 (OSU); OH., Logan Co., 16-VII-1983 (JS); OH., Williams Co., 16-VII-1955 (OSU); OH., Williams Co., 29-VI-1954 (OSU). JS = J. A. Shuey collection; OSU = Ohio State University Collection.

male possesses genitalia (Figs. 3 & 4) which do not differ in any obvious characteristics from the normal variation found in *E. dion* (Figs. 22-33), except that they are smaller. Likewise, the allotype female genitalia (Figs. 5 & 6) are very similar to variation within *E. dion* (Figs. 46-57).

Because every character which Freeman used to differentiate the taxon *E. macguirei* from *E. dion* is questionable, and because I can find no other characters which will separate these two taxa, I suggest that *E. macguirei* be considered a synonym of *E. dion* (Edwards). It is best to consider the type series of this taxon the result of unique rearing conditions.

Euphyes alabamae (Lindsey, 1923). Described from a single male as a race of *E. dion*, the status of this taxon also suffered from a lack of material. As late as 1931, Lindsey, Bell and Williams (1931) had collec-

tively examined only one additional specimen, a female. Clark and Clark (1951) elevated the taxon to specific status, commenting that it exists alongside normal *dion* in the Dahl Swamp of Virginia and that the orange pattern elements reliably separated these two species. They also noted that *E. alabamae* flies in late July, between the broods of *E. dion*. Klots (1951) considered *alabamae* to be a subspecies of *E. dion*, but noted that "a local colony of *A. d. alabamae* has been recorded from Dahl Swamp, Accomac[k] Co., Virginia; a most unusual record", thus, suggesting that these names may represent distinct species. Forbes (1960) accepted *E. alabamae* as a distinct species, reiterating the evidence presented by the Clarks. MacNeill (1975) was more cautious, relegating *alabamae* to a subspecies of *E. dion*, but noted that "a large geographical region of apparent overlap of these two subspecies suggests the need for much more information concerning their relationships." Miller and Brown (1981) re-elevated *E. alabamae* to specific status without comment. Most recently, Opler and Krizek (1984) considered the taxon to fall with in the normal variation of *E. dion*, citing personal communication with John Burns. John Burns (pers. comm.) has elaborated, stating that his position was not based on detailed investigation, but rather an inability to differentiate between these two taxa.

Indeed, when long series of southern "*E. alabamae*" are compared with series of northern *E. dion*, it is evident that wing pattern variation is rampant, and that there is no single character that will separate these supposed taxa. In my examination of long series of the *dion/ alabamae* complex from throughout eastern North America for wing pattern variability, three trends became obvious. First, northern populations are highly variable, and range from individuals that are bright orange (classic *dion*), to individuals that have greatly reduced orange pattern elements (classic "*alabamae*") (Fig. 7). These populations occur throughout glaciated North America, and extend south along the Atlantic Seaboard at least to Virginia. Second, populations from the Gulf Coast States are less variable, and have reduced orange pattern elements (Figs. 8 & 9). These populations match the concept of *E. dion alabamae*, as originally intended by Lindsey (1932). Finally, I describe as a new species one population from extreme southern Mississippi which has non-variable expanded orange pattern elements, and a narrow stigma (Figs. 8 & 9).

Furthermore, male and female genitalic comparisons between northern and southern populations failed to reveal any character that might be useful in separating these taxa. (In fact, all the species of the *dion* group are close [Shuey, 1986], and even easily recognized species such as *E. dukesi* are difficult to consistently separate from *E. dion* using genitalic characters alone [first noted by Lindsey, 1923].)

The original description of *alabamae* was, by necessity, typological. Because Lindsey was describing a single specimen, which obviously

differed from his concept of *dion* from northern states, no intrapopulational variability was considered. Once the concept of two distinct taxa separable by wing pattern became widespread (expanded orange = *E. dion*; reduced orange = *E. alabamae*), authors such as Clark and Clark (1951) and Forbes (1960) mistook variable populations as evidence for the sympatric occurrence of two distinct species. The material I have examined from the Dismal and Dahl Swamps of Virginia, do not substantiate any pattern of discrete broods between the two phenotypes. Because the *alabamae* phenotype can be found throughout North America and the only apparent difference between northern and southern populations is the reduction of phenotypic variability in the south, *alabamae* (Lindsey, 1923), should be relegated to a synonym of *E. dion* (Edwards).

A population from Bay St. Louis, Hancock County, Mississippi, differs from all known populations of *Euphyes*, and is here described as new.

***Euphyes bayensis* Shuey new species**

Description. Male genitalia and female genitalia variable, placing the species within the *dion* group of *Euphyes*, but not different in detail from *E. dion*. Male stigma narrower ($\bar{x}$=0.52±0.04 mm) than in *E. dion* ($\bar{x}$=0.79±0.09 mm). Facies distinctive in several respects (Figs. 8-9); in both sexes, the orange and melanic colors are washed-out (paler) relative to *E. dion* (this difference is less noticeable ventrally); in males the forewing orange pattern elements are expanded and completely encircle the stigma (Fig. 8); female pattern variable, but always with conspicuous orange pattern elements on dorsal surfaces of both wings. Size; male forewing costa = 16.63±0.48 mm; female forewing costa = 18.5±0.53 mm.

Etymology. In the tradition of *Euphyes pilatka*, with which it flies, the name refers to the type locality.

Type Deposition. The entire type series was collected at Bay St. Louis, Hancock County, Mississippi by R. Kergosien. The holotype (19-IX-1970) and allotype (12-IX-1970) are deposited in the Carnegie Museum of Natural History. Paratypes are deposited as follows; three males (18-IX-1970, 10-IX-1970, 12-IX-1970), Carnegie Museum of Natural History; two males (9-IX-1970, 4-IX-1970) and one female (8-IX-1970), National Museum of Natural History; two males (21-IX-1970, 12-IX-1970) and one female (8-IX-1970), American Museum of Natural History; one male (17-IX-1970) and one female (18-IX-1970), Mississippi Entomology Museum at Mississippi State University; one male (10-IX-1970) and one female (18-IX-1970), Mississippi Natural Science Museum, Jackson; two males (both 19-IX-1970), The Florida State Museum at the University of Florida; one male (27-IX-1970), The Ohio State University; six males (two 19-IX-1970, two 10-IX-1970, 17-IX-1970, 19-IX-1970) and one female (18-IX-1970), J.A. Shuey collection;

and, 10 males (two 29-VIII-1970, 12-IX-1970, 17-IX-1970, three 18-IX-1970, two 19-IX-1970, 27-IX-1970) and three females (3-IX-1970, 21-IX-1970, 21-IX-1970), B. Mather collection. Three additional males (10-IX-1970, 17-IX-1970, 25-V-1971) in poor condition have been returned to B. Mather.

Discussion

My decision to describe *E. bayensis* as a new species is based on morphological and limited biological evidence and as such, is open to alternate interpretations. Although the male and female genitalia fall within the range of variation of *E. dion* (Figs. 10-57), wing pattern and stigma configuration differ consistently between *E. bayensis* and all *E. dion* populations (Fig. 8-9). Wing pattern differences include:

1. Color. The melanic ground color and the orange pattern elements are paler in both sexes of *E. bayensis* than in *E. dion* (Figs. 8 & 9). These differences are most noticeable above, and are less apparent ventrally. This color difference is real, and is not due to wear associated with flown specimens or fading of older specimens (all of the specimens figured were captured between 1970 and 1973).

2. Male pattern. Males of *E. bayensis* have consistently expanded orange pattern elements compared to males of *E. dion* from Mississippi. *Euphyes dion* males from the variable northern populations (Fig. 7) commonly approach the extent of orange pattern found, but southern populations of *E. dion* are less variable and are consistently dark. A graphic plot of one pattern element, the extent of orange along forewing vein V_2 (Fig. 58) reveals the trend towards the expansion of this element in *E. bayensis*.

3. Female pattern. Females of *E. bayensis* have consistently greater orange pattern elements than both northern and southern populations of *E. dion* (Figs. 8 & 9). The graphic plot of one pattern element, the extent of orange along forewing vein V_2 (Fig. 59), reveals that there is no overlap of variation between *E. bayensis* and Mississippi *E. dion*.

The most compelling morphological difference is the male stigma which is consistently narrower in *E. bayensis* than in populations of *E. dion* (Figs. 8 & 9). This relationship is demonstrated graphically in Figure 60. There is minimal overlap in stigma width between *E. bayensis* and *E. dion*.

Preliminary biological evidence for the specific differentiation of these taxa includes:

1. Habitat. The type series of *E. bayensis* was captured in a brackish marsh where it flies with *Euphyes pilatka*. *Euphyes dion* has never before been reported as a breeding resident in a brackish habitat (although the type locality of *E. alabamae*, Mobile Bay, is primarily a brackish complex) and normally occurs in fresh water wetlands; *E. dion* usually flies with *E. dukesi* in Mississippi (C. Bryson, pers. comm). Similar habitat differences separate other closely related pairs of

wetland butterflies and may be indicative of the speciation pattern of species that are restricted to these habitats (e.g., *E. dion* and *E. dukesi*; *Lyceana epixanthe* (Boisduval and LeConte) and *L. dorcas* Kirby; *Satyroides eurydice* Johannson and *S. appalachia* (Chermock); and *Poanes viator viator* (Edwards) and *P. viator zizaniae* Shapiro (see Shapiro, 1970; Shapiro and Cardé, 1970; Shuey, 1985).

2. Hostplant. The only known habitat is brackish, and dominated by sawgrass. Charles Bryson (pers. comm.) could not find *Carex hyalinolepis* Steud., the hostplant of *E. dion* in Mississippi, in the marsh. Thus it seems probable that *E. bayensis* does not use this *Carex* as the host.

3. Sympatry. Two specimens referable to *E. dion* (based on pattern) are known from the type locality (Fig. 61) and this species is generally distributed throughout Mississippi. The stigmas of these specimens are intermediate between *E. bayensis* and *E. dion* (Fig. 60). This evidence can be interpreted in two ways. I prefer to consider this as evidence of the sympatric distribution of closely related species. Supporting this position are; 1, the pattern and color of these two specimens which clearly places them as *E. dion*; and 2, the absence of intermediates between *E. bayensis* and *E. dion* from Bay St. Louis. However, the presence of these two males could also be interpreted as indicating that one species is represented at Bay St. Louis, and that intermediate phenotypes have simply not yet been collected.

Obviously, the biological evidence presented here needs to be confirmed, and additional populations of *E. bayensis* need to be located.

Acknowledgements. The entire type series of *E. bayensis* was brought to my attention by Bryant Mather, to whom I am deeply indebted. Other material was obtained from J.M. Burns (National Museum of Natural History); F.H. Rindge (American Museum of Natural History); M.D. Bowers (Museum of Comparative Zoology); J.E. Rawlins (Carnegie Museum of Natural History); J. Liebherr (Cornell University); C. Triplehorn (The Ohio State University); J.W. Peacock (Marion Ohio); and J.V. Calhoun (Westerville, Ohio). Charles Bryson (Stoneville, Mississippi) kindly permitted me access to copies of letters written by him to B. Mather. Roy Kendall (San Antonio, Texas) provided information about *E. macguirei*. Gordan R. Stairs and Richard L. Miller, The Ohio State University, provided access to laboratory space and photographic equipment respectively. John W. Peacock (Marion, Ohio), David C. Iftner (Worthington, Ohio), and Bryant Mather (Clinton, Mississippi) commented on earlier drafts. Finally, John M. Burns briefly examined part of the type series and, unknowingly, encouraged a lepidopterist who was otherwise discouraged about describing such a subtly differentiated taxon.

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Figs. 8 and 9. Phenotypic variation of wing pattern in *Euphyes bayensis* n. sp. and Mississippi *E. dion*.

Fig. 8. Dorsal wing pattern. **First Column**, *E. bayensis* n. sp., top to bottom (all Bay St. Louis, Mississippi.); Holotype male, 19-IX-1970; male, 17-IX-1970; male, 17-IX-1970; Allotype female, 12-IX-1970; female, 21-IX-1970. **Second column**, *E. bayensis* n. sp., top to bottom; male, 18-IX-1970; male, 19-IX-1970; male, 10-IX-1970; female, 3-IX-1970; female, 10-X-1970. **Third column**, *E. dion* top to bottom (all Mississippi); male, Lowndes Co., 26-VI-1973; male, Lee Co., 1-IX-1973; male, Lowndes Co., 8-IX-1973; female, Clay Co., 9-IX-1972; female, Lowndes Co., 10-IX-1972. **Fourth column**, *E. dion*, top to bottom; male, Clay Co., 13-IX-1972; male, Lowndes Co., 26-VI-1973; male, Lee Co., 8-IX-1973; female, Lowndes Co., 26-VI-1973; female, Lowndes Co., 9-IX-1973.

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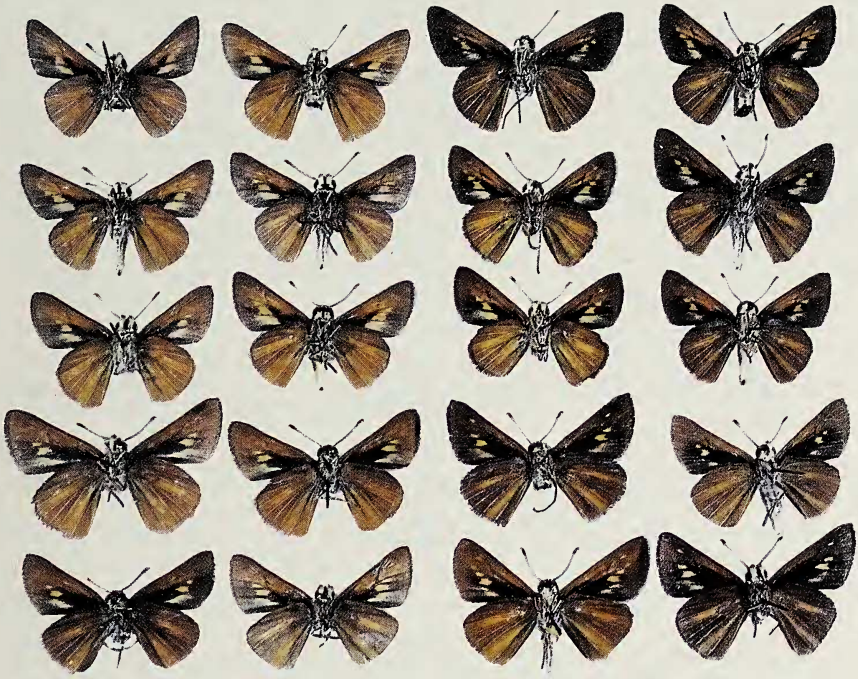

Fig. 9. Ventral wing pattern. Legend as in Figure 8.

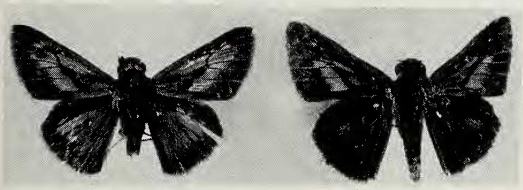

Fig. 61. *Euphyes dion* from Bay St. Louis, Mississippi. Left to right; 12-IX-1970; 2-IX-1970.

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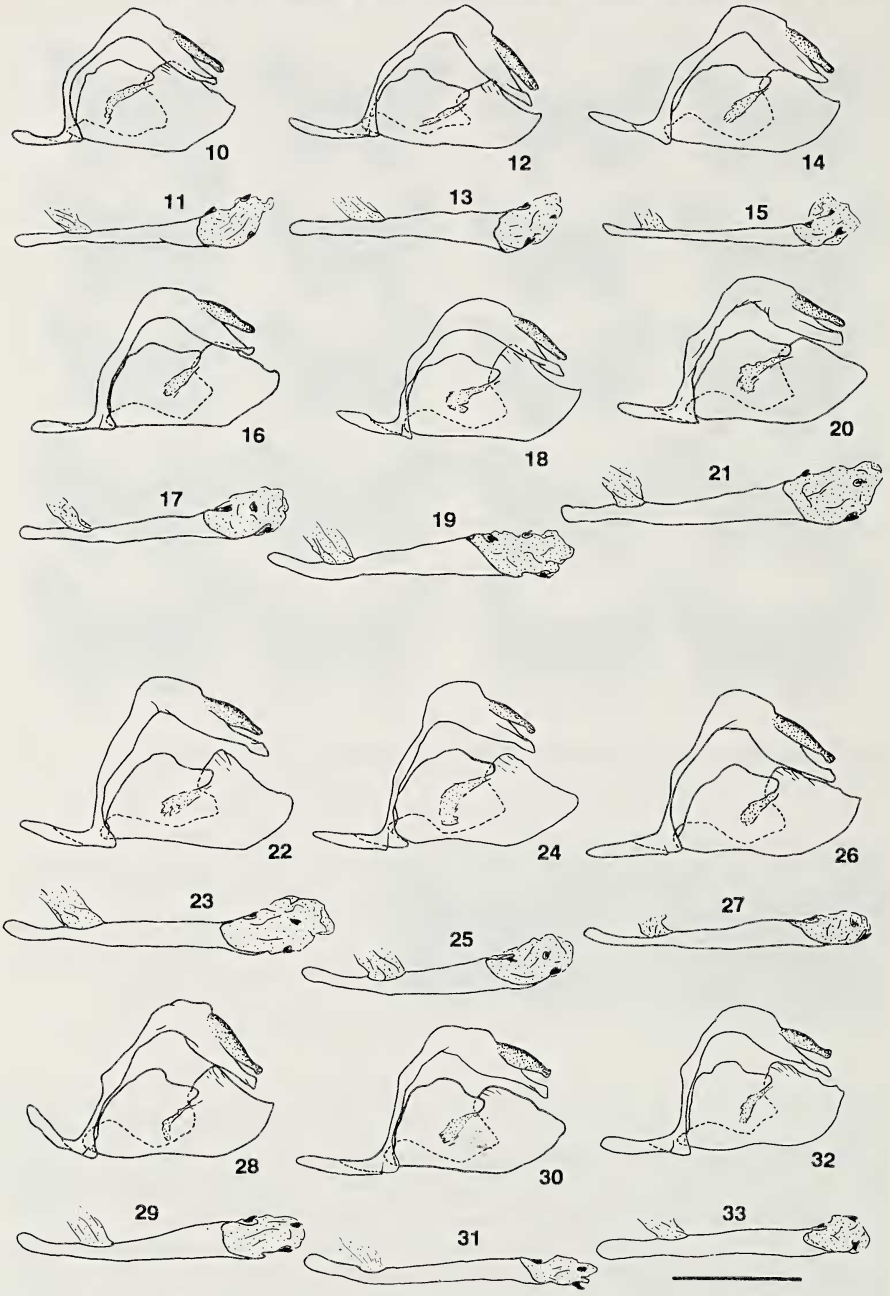
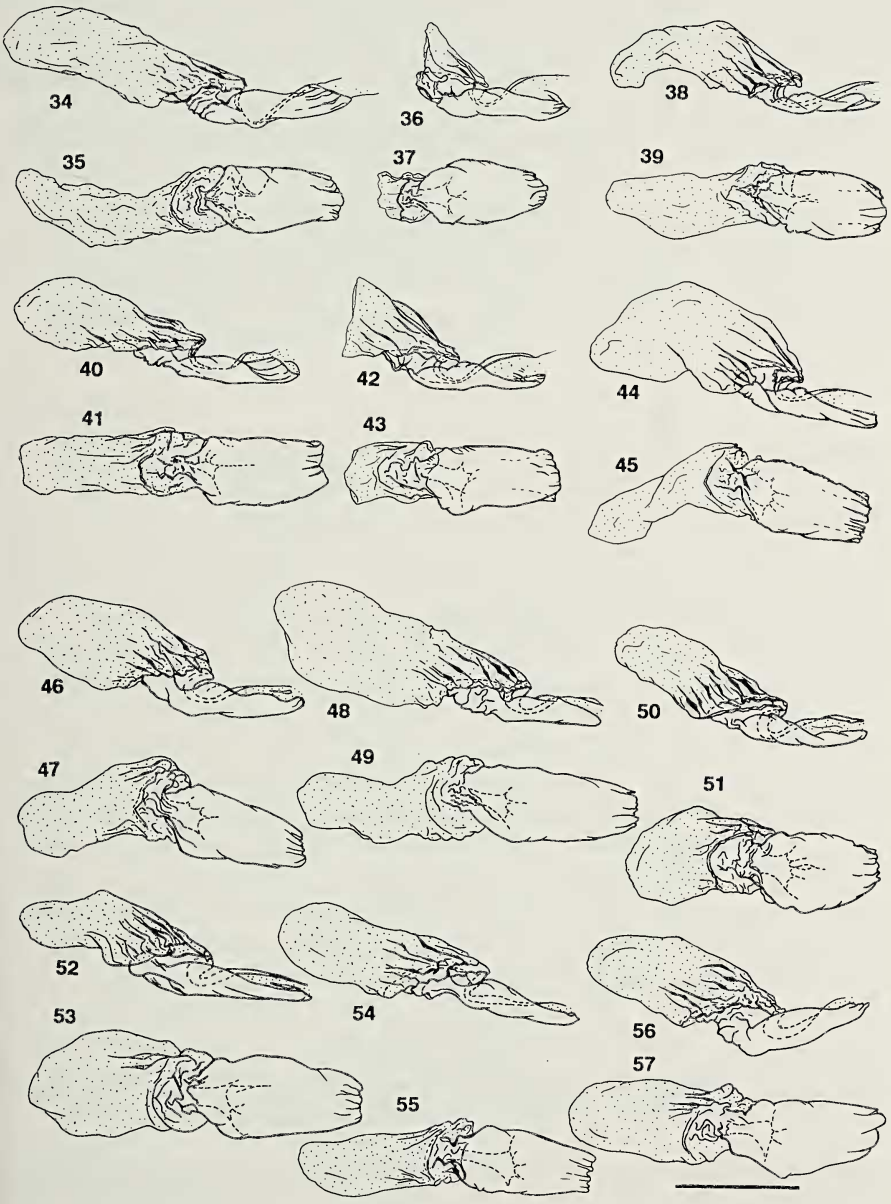
Figs. 10-33. The range of variation of male genitalia of *Euphyes bayensis* n. sp. and Mississippi *E. dion* (lateral view). Scale line = 2 mm.



Figs. 10-21. all *E. bayensis* n. sp., Bay St Louis, Mississippi; 10-11, 17-IX-1970; 12-13, 18-IX-1970; 14-15, 19-IX-1970; 16-17, 17-IX-1970; 18-19, 12-IX-1970; and 20-21, 21-IX-1970.

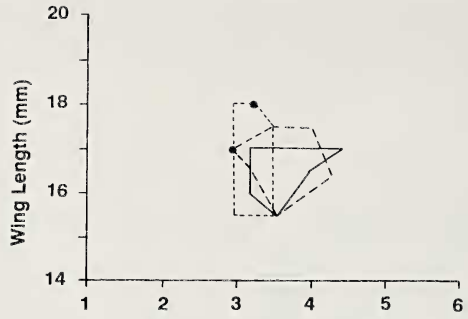
Figs. 22-33. all *E. dion*, Mississippi; 22-23, Lowndes Co., 26-VI-1973; 24-25, Lowndes Co., 8-IX-1973; 26-27, Lowndes Co., 3-IX-1973; 28-29, Lee Co., 1-IX-1973; 30-31, Lee Co., 1-IX-1973; and 32-33, Clay Co., 13-IX-1973.

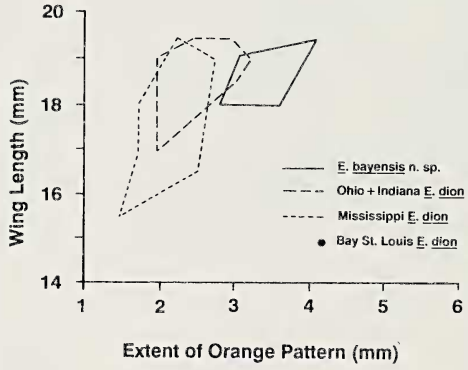
Figs. 34-57. The range of variation of female genitalis of *Euphyes bayensis* n. sp. and Mississippi *E. dion* (even numbers, lateral view; odd numbers, ventral view). Scale line = 2 mm.

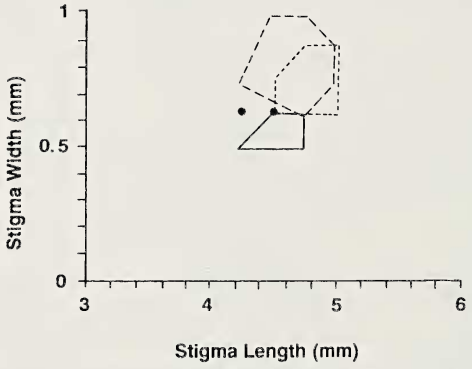


Figs. 34-45. All *E. bayensis* n. sp., Bay St. Louis, Mississippi; 34-35, 8-IX-1970; 36-37, 10-IX-1970; 38-39, 18-IX-1970; 40-41, 3-IX-1970; 42-43, 10-X-1970; and 44-45, 12-IX-1970.

Figs. 46-57. all *E. dion*, Mississippi; 46-47, Lowndes Co., 16-IX-1973; 48-49, Lowndes Co., 17-IX-1973; 50-51, Lowndes Co., 16-IX-1973; 52-53, Lowndes Co., 9-IX-1973; 54-55, Lowndes Co., 8-IX-1970; and 56-57, Clay Co., 9-IX-1972.







Figs. 58-60. Comparisons of pattern and stigma variation among *E. bayensis* n. sp., and Mississippi and Ohio + Indiana *E. dion*.

Fig. 58. Male forewing length versus extent of orange pattern along forewing V_2. Note the two specimens of *E. dion* from Bay St. Louis, which fall outside of the range of variation of *E. bayensis*, but within the range of variation of Mississippi *E. dion*.

Fig. 59. Female forewing length versus extent of orange pattern along forewing V_2.

Fig. 60. Stigma length versus width. Note that the two specimens of *E. dion* from Bay St. Louis fall between the ranges of variation for *E. bayensis* and Mississippi *E. dion*.